ORIGINAL RESEARCH

Improvement of Cervical Lordosis and Reduction of Forward Head Posture with Anterior Head Weighting and Proprioceptive Balancing Protocols

E. Stephen Saunders, D.C.[1] Dennis Woggon B.S, D.C.[2]
Christian Cohen B.S. D.C.[3] David H. Robinson, PhD.[4]

ABSTRACT

Background and Objectives: Evidence of the kinesiopathological component of the vertebral subluxation complex is frequently apparent in observation and assessment of posture. Postural distortion from loss of the normal cervical lordosis has been referred to as forward head posture (FHP) and may precipitate pain, decreased ranges of motion and other health problems. FHP can be quantified by measurement of neutral lateral cervical radiographs. The objective of this study was to determine if the use of head weighting and balancing protocols could improve the cervical curvature and head carriage.

Methods: One hundred and thirty one patients from six Chiropractic clinics in the United States, two in Canada and one in the Russian Federation participated in the study. Study participants were randomly selected and assessed with neutral lateral cervical radiographs. These patients performed motion activities while wearing three or five pounds of weight on the front of their heads for five minutes then a weighted stress lateral cervical film was taken.

Results: A comparison of the measured results from the two films was made considering the cervical lordosis and FHP. Average improvements in the cervical lordosis of 34% ($p < .0001$) and in FHP 14mm ($p < .0001$) were noted after the head weighting protocol was preformed with five pounds. Improvement of cervical lordosis of 31% ($p < .001$) and in FHP 18mm ($p < .0001$) was recorded in a group using three pounds of weight.

Conclusion: Head weighting may prove to be a useful therapeutic tool in addressing FHP and the concurrent loss of the normal cervical lordosis.

Key words: *cervical lordosis, forward head posture, anterior head weighting, proprioceptive retraining, wobble chair, vertebral subluxation.*

Introduction

The biomechanical ideal configuration for the human cervical spine is a posterior concave arc or lordosis.[1,2,3] This positions the center of gravity of the skull over the mid cervical vertebrae.[4] The loss or reversal of the normal cervical lordosis and attendant forward head posture has long been identified with numerous consequential health problems[5] including decreased vital lung capacity,[6] cervical, interscapular and headache pain,[7,8] and temporomandibular disorders.[9] Many symptoms may be moderated or eliminated by improving posture.[10] Chiropractors and other health care professionals have attempted to measure and correct these postural problems through spinal adjustments and rehabilitative protocols. Successes in changing forward posture through spinal adjusting and other therapeutic activities have been reported but routine predictable changes have not. Published opinion and unpublished clinical research has suggested that purposefully attached external weights can cause the body's righting reflexes to react and correct posture to a more ideal state.[10,11] Proprioceptive balance activities have been used therapeutically in recent times and studies show that stimulation of sensory receptors in spinal ligaments elicits reflex activity in the paraspinal muscles and contributes to maintaining spinal stability.[11,12,13] There are five righting reflexes[14] that relate to proprioception (orientation in time and space). See Table 1, page 2.

To our knowledge, no literature exists that combines proprioceptive activities with corrective external weighting protocols to produce postural improvements that are measurable on radiographs.

Methods and Materials

One hundred and thirty one patients from six Chiropractic clinics in the United States, two in Canada and one in the Russian Federation participated in the study. Eighty female and

1. Locum tenens, Seattle Washington
2. Private Practice St. Cloud, Minnesota
3. Private Practice Kankakee, Illinois
4. Professor and Chair, Department of Statistics, St. Cloud State University, St. Cloud, Minnesota

Table 1: The Five Righting Reflexes

Labyrinthine	(inner ear)	maintains the head's orientation in space (medulla)
Optic	(ocular)	keeps the head in proper orientation to its gravitational environment (occipital cortex)
Neck righting reflex	(joints of the neck)	keeps the body orientated to the head (medulla).
Body righting reflex	(body surface receptors)	orientates the body in space (medulla).
Body righting reflex #2		keeps the head, oriented to the body (midbrain).

fifty-one male patients were tested. There ages ranged from 11 to 92 years. Patients were consecutively selected for the study from the pool of incoming new patients in each field practice. They were evaluated before any therapeutic intervention. Neutral lateral cervical views were taken. Films were analyzed and loss of the cervical curve measured, using Jackson's Angles.[2] George's lines were extended down from the posterior margin of the second cervical vertebral body and up from the posterior margin of the seventh cervical vertebral body.[15] The angle of intersection of these two lines was measured. The loss of curve was calculated by converting the angle to a percentage of loss by ascribing 2.25 percent loss per degree less than the forty-five degree normal lordosis.[2,16] Kyphotic curves were recorded in percentages greater than 100% and double or triple buckled curves had the separate percentage losses added together.[14] Forward head posture was calculated by measuring the distance between the anterior quarter of the C4 - C5 inter-space and a gravity line that was constructed perpendicular to the superior border of the film that bisected the anterior margin of the sella tursica.[4]

Patients were then fitted with a five- pound anterior head weight made up of chilled lead shot in a cloth headband. Participants in the Russian federation used 1500 grams or approximately three pounds of weight. The headband was velcroed securely around the head with the weight over the frontal and temporal bones. The patient wore this weight while seated on a proprioceptive training chair, The Wobble Chair.™ The chair seat is freely movable on a pivotal axis and allows 20 degrees of pivot off its vertical center, to each point of the compass. The chair allows 360 degrees of rotation. Each patient was instructed to rock backward and forward, from side to side and rotate in circular motions while on the chair. They were instructed to look straight ahead and keep their head and shoulders relatively still while performing these maneuvers. After the subject was timed, continuing these activities for five minutes, a neutral lateral stress radiograph was taken while the patient continued wearing the head weight. This weighted view was analyzed in the same manner as the neutral view and the results were compared. Thirty of the study participants x-rays were consecutively sampled and lines were drawn parallel with the hard palate and the bite line. These were then compared to the edge of the film in the initial and subsequent radiographs to determine if the patient's head and cervical spine were in the neutral position.[18]

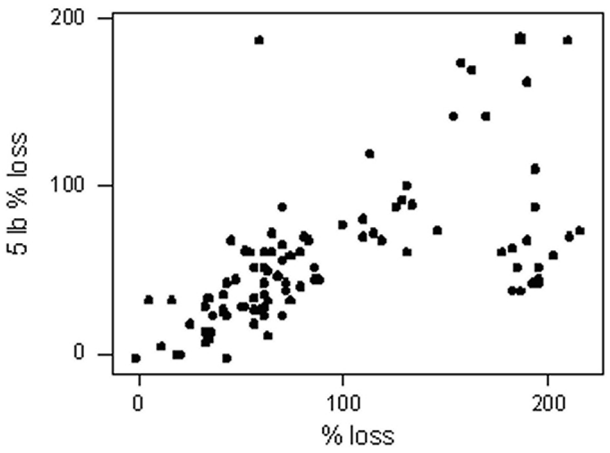
Results

The average loss of the cervical curve was 94% in the North American cohort. 35 of the 97 subjects had kyphotic or kyphotic S curves of the cervical spine. Forward head posture averaged 1.2 inches or 31mm for the 97 subjects. Average loss of curve was 76% in the smaller sample from the Russian Federation. FHP averaged 30mm or 1.1 inches in this smaller sample. Films taken after the proprioceptive training activity, with the subjects weighted, demonstrated average loss of curve improved from 94% to 58% loss, a 34% improvement, in the North American study group.

A paired t-test showed this improvement to be highly significant in a statistical sense ($t = 7.20$, $p < .0001$). Data from the Clinic in Vladivostok identified average improvements from 76% loss of curve to 45% loss of the cervical lordosis, a 31% improvement. A paired t-test showed this improvement to also be highly significant in a statistical sense ($t = 3.92$, $p < .001$). Forward head posture improved from an average of 31 to 17 mm, for a total of 14 mm improvement of anterior head transla-

Patient performs proprioceptive exercises on Pettibon Wobble Chair™ with five pounds of anterior head weight for five minutes.

Figure 1.



tion in the American cohort. A paired t-test showed this improvement to be highly significant ($t = 13.11$, $p < .0001$). The Russian sample showed an average of 18 mm improvement, again highly significant ($t = 8.50$, $p < .0001$). The sample of thirty patients in the American cohort showed an average change of 2.70 degrees of the hard palate angles from the non-weighted to the weighted x-rays. This verifies that there was good consistency with patient positioning.

Further investigation of the relationship of the percentage loss before and after the training activity continued by examining the scatterplot of the two % loss variables in the American cohort. The graph of the 97 subjects is shown in Figure 1.

The patients plotted in the lower right-hand corner of the graph experienced the greatest improvement (reduction) in % loss. These are some of the 35 patients exhibiting kyphotic or kyphotic S curves of the cervical spine. The North American cohort was then separated into two subgroups. Group 1 was the 35 subjects with kyphotic or kyphotic S curves (% loss greater than 100), while Group 2 were the 62 subjects not exhibiting this condition. (In Figure 1, Group 1 is all points on the right side and Group 2 is all points on the left side.) Table 2 summarizes the statistical information from the two groups.

Table 2: North American Cohort (training with 5 lb)

	Group 1 N = 35	Group 2 N = 62	Overall N = 97
Before training, Mean % Loss	166%	54%	94%
(Std Error of Mean)	(6%)	(3%)	(6%)
After training, Mean % Loss	93%	39%	58%
(Std Error of Mean)	(8%)	(4%)	(5%)

Separate t-tests were run on the two groups to see if each group exhibited significant improvement. For Group 1, the average loss of curve improved from 166% to 93%, a 73% improvement. The paired t-test showed this to be a highly significant improvement ($t = 7.53$, $p < .0001$). For Group 2, the average loss of curve improved from 54% to 39%, a 15% improvement. The paired t-test showed this to also be a highly significant improvement ($t = 4.50$, $p < .0001$). There was no significant difference in age or gender composition between the two groups.

Discussion

Case reports in the chiropractic literature have demonstrated positive changes in the cervical lordosis as a result of specific chiropractic care. Wallace et al have reported a close association between changes in the cervical curve and decreased subjective symptoms.[17]

A comparison of the data from the North American sites and the Russian Federation revealed a surprising consistency and has suggested that there is a range of weight that produces beneficial changes. Prior to the trial, clinical observations had suggested that three pounds was insufficient to produce the desired changes in individuals with significant degenerative joint disease in the cervical spine. Due to the fact that the Russian participants were younger and with less pathology, this may suggest utilizing a 3-pound head weight on a non-pathological cervical spine and a 5-pound head weight where osteoarthritic degenerative changes are present. The amount of the weight may also be varied based on patient strength, stature and comfort.

One subject demonstrated a significant worsening of the lordosis and the magnitude of forward head posture. It is speculated that this individual was of slight stature and with her relatively small muscle mass, the cervical spine buckled with the five-pound weight.

An important and pertinent finding from this study was that the changes in the cervical curve and forward head posture were produced within five minutes without any other therapeutic intervention other than the proprioceptive activity while wearing the head weight. The study did not evaluate whether the changes were apparent after the subject removed the head weight or whether the protocol produced lasting changes. Further study is necessary to evaluate these questions.

It was also noted that the kyphotic and kyphotic S-curved necks responded better than a lordotic S-curve or a hypolordotic curve. It is unknown why individuals with kyphotic or kyphotic-S curves showed such large improvements during the head weighting protocol. This may simply be a product of the magnitude of the percentage loss of curve calculated in the kyphotic-S configurations. It may represent rapid adaptation to the imposed demands of the weight with an unstable spine and demonstrate the spines ability to alter structure to a more efficient configuration.

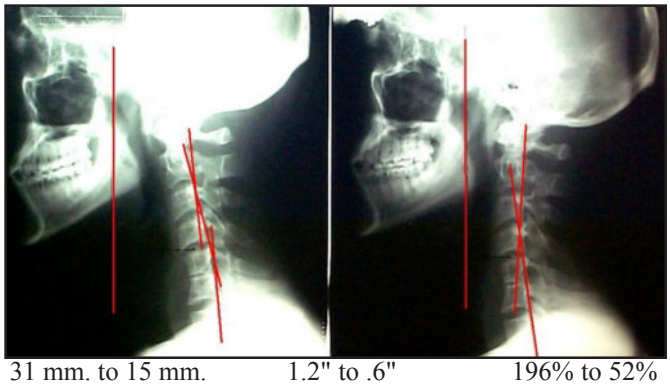
It is proposed that external head weighting is based on adaptive principals, forcing the body to react in ways that produce a more optimum posture. The frontal head weight imbalances the skull, which in turn activates the extensor muscles that then cause the front of the skull to rotate upward. The upward rotated skull causes the optic and labyrinthine righting reflexes as well as the mechanoreceptors and body surface receptors to bring the optic righting reflex in line with the horizon by activating the cervical flexor muscles.

Conclusions

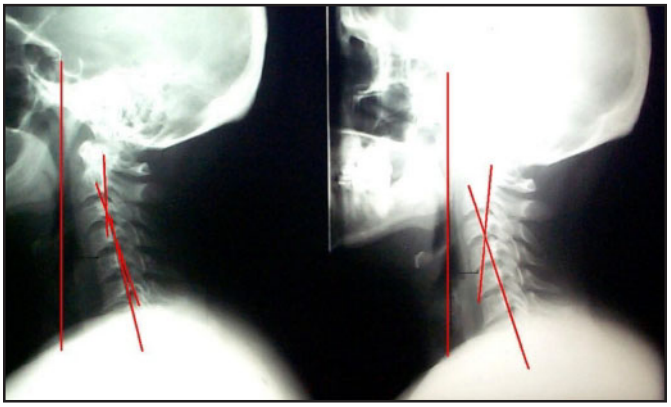
Anterior head weighting combined with proprioceptive retraining activities produced significant and immediate improvements in forward head posture in a sample group. The encouraging initial results demonstrate large improvements in static posture. This suggests that these simple therapeutic protocols

may be recommended to patients with health problems related to forward head posture and combined with traditional adjusting approaches to produce significant postural improvements. These inexpensive, low-tech activities can be administered as active care protocols that, after coaching, can be performed by patients without provider supervision at home. Additional studies are needed to determine the long-term effects of this adjunctive rehabilitation to ascertain if this protocol makes lasting changes to the posture and function of the spine.

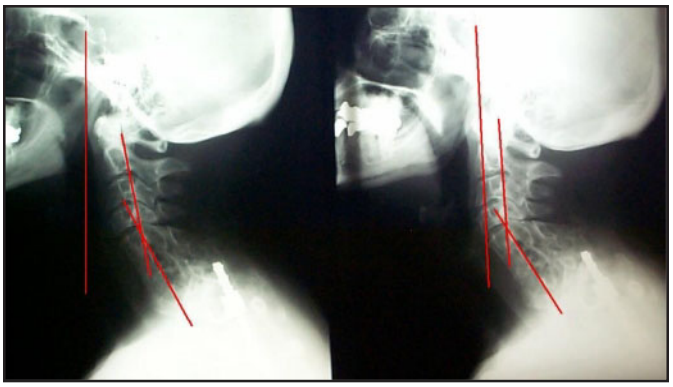
32 mm. to 15 mm. 1.3" to .6" 41% to 7%



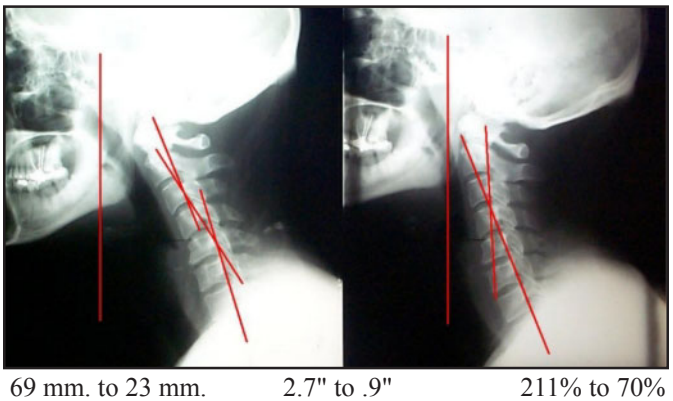
31 mm. to 15 mm. 1.2" to .6" 196% to 52%



61mm. to 31mm. 2.4" to 1.2" 134% to 89%



20 mm. to 0 mm. .8" to 0" 74% to 32%
(Note Harrington Rod)



69 mm. to 23 mm. 2.7" to .9" 211% to 70%

Acknowledgments

This study utilized data submitted by Gary C. Lawrence D.C., Stillwater Minnesota; David W. Butler B.E.S., D.C., Alexandria Minnesota; Ian J. Horseman D.C., Toronto Canada; Martin K. Kuwamoto D.C., Fresno California; William A Watt D.C., Sundre Canada; Michael L. Milasich.D.C., Tacoma Washington, Jeffrey A. Cronk D.C., Seattle Washington and St. Cloud Chiropractic Clinic, St. Cloud MN. Alexey Ushkov M.D. and his colleagues made a substantial contribution from "Spine" the Regional Center for Chiropractic in Vladivostok, Russia. The Chiropractic Leadership Educational Advancement and Research Institute in St. Cloud Minnesota funded consulting fees for David H. Robinson PhD for statistical analysis.

References:

1. Harrison DD, Janik T, Troyanavich S, Holland B, Comparisons of Cervical Spine Curvatures to a Theoretical Model of the Static Sagittal Cervical Spine, Spine 1996 21: 667-675
2. Jackson R, The Cervical Syndrome 3rd Edition: 35-42, Charles C Thomas Publisher 1971
3. Pettibon BR, Harrison DD, Pettibon Spinal Biomechanics Theory and Implications, 2nd Edition, Pettibon Biomechanics Institute1984
4. Kapandji I A, Physiology of the Joints Volume 3, Churchill Livingston 1974
5. Wallace HL, Jahner S, Buckle K, Desai N: The Relationship of Changes in Cervical Curvature to Visual Analog Scale, Neck Disability Index Scores and Pressure Algometry In Patients with Neck Pain. Journal of Chiropractic Research and Clinical Investigation, Volume 9 (1) 19-23 1994
6. Cailliet R, Rejuvenation Strategy, 52-58 Doubleday and Co 1987 52-58
7. Greigal-Morris P, Larson K, Mueller-Klaus K, Oatis C A Physical Therapy 1992 June: 72 (6): 425-31
8. Watson DH, Trott PH, Cephalgia 1993 Aug; 13 (4): 272-84
9. Lee WY, Okeson JP, Lindroth J. Journal of Orofacial Pain 1995 Spring: 9(2): 161-7
10. Lennon J, Sealy CN, Cady RK, Matta W, Cox R, Simpson F, Postural and Respiratory Modulation of Autonomic Function, Pain and Health AJPM Jan 94 4(1) 36-39
11. Solomonow M. PhD Spine 1998; 23(23): 2552-2562
12. Cailliet R, Neck and Arm Pain, 2nd Edition 134 FA Davis Company 1981
13. Hongxing J, MB PhD Spine 1997; 22(1): 17-25
14. Chusid, Correlative Neuroanatomy & Functional Neurology, 19th Edition, 1985, 56, Lange Medical Publications
15. Pettibon BR, Woggon D, Pettibon Spinal X-ray System, 1989, Pettibon Spinal Biomechanics Institute
16. Pettibon et al, Introduction to Spinal Biomechanics, 1-19, Pettibon Spinal Biomechanics Institute, 1989
17. Wallace HL, Jahner S, Buckle K, Desai N: The Relationship of Changes in Cervical Curvature to Visual Analog Scale, Neck Disability Index Scores and Pressure Algometry In Patients with Neck Pain. Journal of Chiropractic Research and Clinical Investigation, Volume 9 (1) 19-23 1994
18. Harrison DE, Harrison DD et al. Slight Head Extension: Does it Change the Sagittal Cervical Curve? European Spine Journal 2001; 10 149-153